
Study on Hearing Status of Children Residing Near an Airport

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ABSTRACT

India being an emerging economy, the air traffic movement rate has increased many folds in recent times. As aircrafts produce considerable noise particularly during takeoff and landing, people, including children, inhabiting the neighboring areas of any busy airport get exposed to a lot of noise. In this backdrop, a study was carried out to assess the impact, if any, of airport noise on the hearing status of children staying near an airport. Few educational institutions located near the international airport in Kolkata were approached for carrying out the study. After obtaining permission from the concerned authorities, the assessment was carried out on volunteers from the consenting schools. Initially the sound pressure level was measured at different locations within the institution at periodic intervals. Audiometric assessment was thereafter carried out on fifty - four male students (age range 11-16 years), who were permanent inhabitants of the locality. Forty – eight male students of comparable age group, permanently residing in remote areas in other districts, far away from the airport, constituted the control group. Results indicate that exposed group children, that is, those residing in the vicinity of the airport, had significantly more hearing loss at speech frequency, and compared to the control group children. Degree of impairment was also calculated at 4 kHz and 6 kHz. From the present study it may be concluded that hearing status of children residing in the vicinity of the airport area is getting affected.

Key words : speech frequency, hearing loss, audiometry, transportation noise, Kolkata

INTRODUCTION

Noise, a ubiquitous environmental pollutant, is a public-health issue because it leads to reduced environmental quality, causes annoyance, and might affect cognition and health^[1]. Many children throughout the world, especially those in developing countries, are chronically exposed to high levels of community noise^[2]. The presence of noise is typical in everyday living; however excessive noise exposure can have drastic effects on one's sense of hearing. Sources of excessive noise exposure that may impact on hearing include industrial machinery, music, gunfire and transportation. Transportation has been revolutionized in recent years, while aviation has expanded and changed. The use of air transportation has increased since the early 1960s and is currently a necessity for an urban lifestyle. However, this creates greater intrusion on the communities living nearby to airports^[3]. Aircraft noise emissions appear to be annoying, largely because of their intermittent nature. A met analysis study revealed that among all transport

noise sources, aircraft noise is considered the most annoying source. Children could be particularly vulnerable to the effects of noise because of its potential to interfere with learning at a critical developmental stage, and because they have less capacity than adults do to anticipate, understand, and cope with stressors^[4]. Given that children are more susceptible to environmental stressors than adults because of reduced cognitive capacity to understand environmental issues and a lack of well-developed coping repertoires^[5], an understanding of the way environmental noise affects children's development and functioning at home and school is fundamental to optimizing their learning potential and has implications for teaching practice and health. In this backdrop, the present work has been undertaken to assess the effect of noise on children attending educational institutions and residing near airport area.

MATERIALS AND METHODS

At first, educational institutions situated near the airport, N S C Bose International Airport, Kolkata (Latitude - 22°34' N and Longitude-88°24' E) were approached for permission to get access to carry out the study on children of age 12 - 16 years, who are permanent inhabitants of areas in and around the airport. On obtaining permission, the study was conducted on 54 children, permanently inhabiting the vicinity of the airport; they constituted the Exposed Group (EG). Individuals with congenital hearing problem and those suffering from apparent tympanic membrane rupture, presence of pus or infection in the ear and user of ototoxic drug (self reported) were excluded from the study purview^[6]. 48 children of comparable age group, permanent residents of remote areas^[2] in other districts, far away^[2] from the airport were considered as the Control Group (CG). Information about age (year), nature and duration of daily activity, preliminary socio-economic condition and self reported past incidence of major illness of self and parents were recorded in pre-designed schedule. Basic physical data like body height (cm) using anthropometric rod with an accuracy of 0.1 cm, body weight (kg) using a pre calibrated weighing scale with an accuracy of 0.1 kg, with individuals in light clothing and without shoes, were measured and BMI was calculated. Audiometric test was carried out with a portable audiometer (Arphi MKIII 500) for obtaining the hearing threshold at different frequencies (0.25 kHz-8 kHz)^[7]. The audiometric assessment was carried out on each individual at a time for both ears separately using the air conduction mode in pure tone. The back ground sound level was checked periodically. Hearing impairment was calculated at speech frequency, upto 4 kHz and upto 6 kHz^[8-10]. Degree of hearing impairment was also calculated as per WHO classification^[11]. Obtained data were tabulated and used for further statistical analysis and the chosen level of significance is 0.05.

RESULTS

Sample size (n), age (yr), body height (cm), body weight (kg), BMI (kg.m⁻²) of EG and CG individuals has been presented in table 1.

Table 1: Basic physical and physiological parameters of study participants

	EG	CG
Sample Size	54	48
Age(year)^	14.8 ± 1.64	15.2 ± 3.23
Body Height(cm)^	155.3 ± 11.74	156.5 ± 9.79
Body Weight(kg)	44.5 ± 13.32	46.3 ± 7.73
BMI(kg.m ⁻²)	20.1	21.9

^ns

A Comparison of average hearing threshold of EG and CG individuals at different frequencies has been presented in Fig 1.

Bilateral hearing impairment status of individuals of EG and CG at speech frequency, upto 4 kHz and upto 6 kHz has been presented in fig 2.

Degree of bilateral hearing impairment status at speech frequency, at 4 kHz and at 6 kHz, as per the WHO hearing impairment guideline of EG and CG individuals has been presented in fig 3.

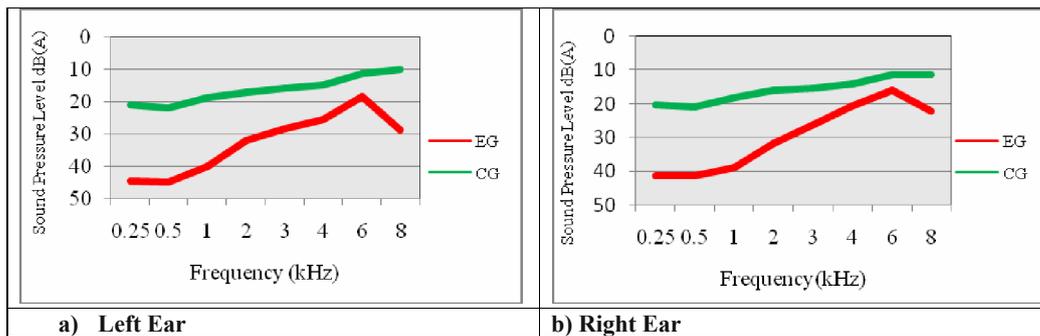


Fig 1: Comparison between EG and CG individuals in respect of average hearing threshold in left (a) and right (b) ears.

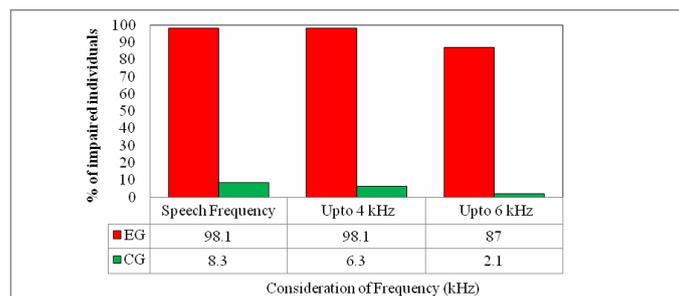


Fig 2: Comparison between EG and CG individuals in respect of bilateral hearing impairment status at speech frequency, upto 4 kHz and upto 6 kHz

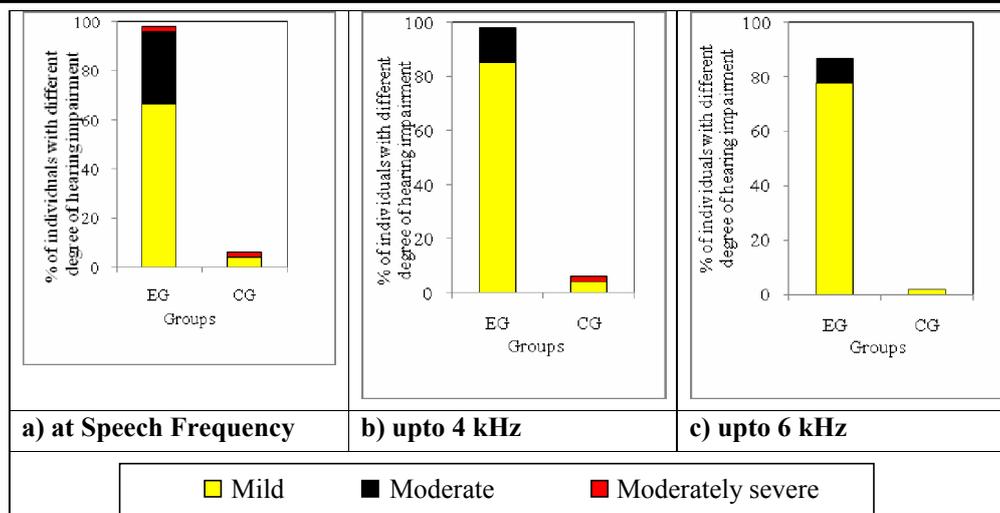


Fig 3: Comparison between EG and CG individuals in respect of Degree of bilateral hearing impairment status

DISCUSSIONS

In table 1, the age (year), body height (cm), body weight (kg), BMI (kg.m⁻²) have been presented in AM ± SD form. EG and CG individuals do not differ significantly in respect of age (year) and body height (cm).

The average hearing threshold of EG and CG individuals in dB (A) has been presented for left (figure 1a) and right (figure 1b) ears. At **speech** frequency (0.5-2 kHz), for **left** ear, in case of EG individuals, the average hearing threshold was from 44.8 to 31.9 dB (A) and for CG counterparts, it was from 22.0 to 17.0 dB (A). At speech frequency, in case of EG individuals the right ear average hearing threshold was from 41.4 - 31.6 dB (A) and for CG counterparts, it was 21.0 to 16.0 dB (A). At **higher** frequencies (4-8 kHz), for left ear, in case of EG individuals the average hearing threshold was from 25.4 to 26.8 dB (A) and for CG counterparts, it was 14.8 to 10.0 dB (A). In case of EG individuals, the right ear average hearing threshold was from 20.7 to 22.1 dB (A) and for CG counterparts, it was 14.0 to 11.2 dB (A).

Hearing threshold shift is more in lower frequencies compared to higher frequencies for both left and right ears [fig 1(a) and 1 (b)]. The findings of the present study are in agreement with the observation of Chen and others^[12], who also worked with children attending schools near airport. They reported that, NIHL was higher in children who attended a school located under a flight path near an airport in Taiwan, as compared to children at another school far away from the airport. Chen and others^[13] also had reported that hearing ability was reduced significantly in individuals who lived near an airport and were frequently exposed to aircraft noise. Pillay^[3] et al reported that, the positive relationship between the pure tone audiometric

test results and the distortion product otoacoustic emissions strengthens the argument that aircraft noise affects the hearing patterns of people who reside close to the airport.

The present study has been conducted on 54 EG and 48 CG individuals. At speech frequency, 98.1% EG individuals and 8.3% CG individuals had bilateral hearing impairment. When the frequency upto 4 kHz was taken into consideration, 98.1% of EG individuals and 6.3% CG individuals were found to have bilateral hearing impairment. When the frequency upto 6 kHz was taken into consideration 87.0% of EG individuals and 2.1% of CG individuals were found to have bilateral hearing impairment (fig 2). In the present study, a significant difference ($P < 0.01$) has been observed between EG and CG individuals in respect of their impairment status for all three considerations.

As per WHO hearing impairment classification, at speech frequency, bilaterally, 66.6% of EG individuals had 'mild' degree, 29.6% had 'moderate' degree and 1.9% had 'moderately severe' degree of hearing impairment, and for CG counterpart, bilaterally, 6.2% individuals had 'mild' degree and 2.1% individuals had 'moderately severe' degree of hearing impairment. When considered, upto 4 kHz bilaterally, 85.2% of EG individuals had 'mild' degree and 12.9% had 'moderate' degree of hearing impairment, and for CG counterparts 4.2% individuals had 'mild' degree and 2.1% individuals had 'moderately severe' degree of hearing impairment. When considered upto 6 kHz, bilaterally, 77.7% of EG individuals had 'mild' degree and 9.3% of individuals had 'moderate' degree of hearing impairment, and for CG counterparts 2.1% of individuals had 'mild' degree of hearing impairment [fig (3a), (3b), (3c)]. The findings of the present study that children attending schools near an airport are suffering from hearing loss are in agreement with other reports from ^[14, 12]. The cohort study ($n = 379$) demonstrated significantly worse standard pure tone average, high pure tone average, and threshold at 4 kHz in children with frequent exposure to aircraft noise (20 flights overhead daily) as compared with age-matched controls ^[12].

The present study revealed that, EG individuals staying and attending schools near an airport, had significantly raised hearing thresholds at lower frequencies and also increased prevalence of hearing impairment. This may be attributed to loss of structural integrity of the stereocilia ^[15], or reduction in ability of stereocilia to act as mechano-electrical transducer due to loss of permeability of protein transduction channels in the cell membrane surrounding the stereocilia ^[16] or due to removal of the tips of the stereocilia on outer hair cells (OHC) from their point of insertion with the tectorial membrane ^[17]. On the basis of the present study it may be concluded that the EG individuals residing and attending schools in an around airport are more affected compared to the CG counterparts in terms of the degree of hearing impairment status.

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